

organization to the FAA for hypersonic overflight above PCA. Immediate FAA notification for priority airspace would be made in the event of an abort. Consultation with FAA will be conducted during preparation of EA-II to verify current policy, and therefore final airspace impact determination is deferred to Phase II.

4.2.4 Biological Resources

Impacts to all biological resources at EAFB will be either minimal or can readily be mitigated to minimal levels. Of the five major plant communities on EAFB, only the halophytic and arid phase saltbush scrub communities are likely to be impacted by site preparation and operation activities related to the X-33 Program. Preliminary data indicate that the total area to be prepared would be approximately 4 ha (10 ac). Given this small size and the large amount of arid phase saltbush scrub at EAFB, this area is relatively small. Impacts to overall plant community and wildlife habitat values will be minimal. No wetlands or floodplains will be impacted.

Impacts to biological resources at WSMR will be minimal and depend on the takeoff site selected. At the WSSH site, there will be no impact to any biological resource. The site is on an alkali flat in a dry lakebed. Due to its corrosive nature, no plant or animal species regularly inhabit the site. WSMR LC-39 is low dune land. Vegetation has been characterized as mesquite scrub. The only wildlife found on this site is the Texas horned lizard. If a vertical landing vehicle is selected, a landing pad will be placed near the takeoff site. Its proximity to the takeoff site will result in no additional impact other than that resulting from takeoff site preparation and operation. Due to the small size of the site (approximately 4 ha (10 ac)) and the fact that this area has been used for launch operations in the past, the biological impact will be minimal. No wetlands or floodplains will be impacted.

Impacts to biological resources at the ER will depend on the selected spaceplane configuration and the takeoff complex used. Habitat likely to be affected at SLC-37, regardless of spaceplane configuration, is largely coastal strand and coastal scrub. Most, if not all, of the area to be impacted has been previously cleared for construction of the complex in the 1960's. Natural habitat in the area is largely due to the natural recolonization of scrub and strand species. These habitats are relatively plentiful on the range (more than 50,000 ha (123,000 ac) coastal scrub and more than 600 ha (1,500 ac) of coastal strand). The amount of previously undisturbed habitat required to be cleared is expected to be very small to none. Any scrub habitat removed would be compensated for under the KSC Scrub Compensation Plan (see Section 4.2.5). For KSC LC-39 and a horizontal lander, no impacts are expected to any natural resource because no new facility construction is anticipated. For a vertical lander, a landing pad would have to be placed in close proximity to the complex. Most areas surrounding KSC LC-39 are wetlands; therefore, it is expected that the landing pad would result in the unavoidable removal of wetland habitat since flight support requirements have strict siting requirements for the safe use and handling of highly energetic propellants. The specific species impacted would have to be determined following more detailed design. However, preliminary data indicate that the total area to be prepared would be approximately 4 ha (10 ac). Given this small size and the large amount of wetland vegetation on KSC (over 20,000 ha (50,000 ac)), this area is relatively small. In addition, opportunities for mitigation actions exist on KSC to compensate for this loss. No floodplains will be impacted. Therefore, impacts to biological resources on the ER are expected to be minor and capable of being mitigated.

4.2.5 Threatened, Endangered, and Sensitive Species

All three ranges have threatened, endangered, or sensitive species residing on or migrating through them. Mitigation will differ at each site depending on the specific species found there. A listing of the threatened, endangered, and sensitive species occurring or potentially occurring on each range is provided in Appendix B.

Over 30 sensitive plant and animal species reside on EAFB. Only three are associated with the proposed takeoff sites: the desert tortoise, Mojave ground squirrel, and alkali mariposa lily. Proposed activities are not located in designated critical habitat for these species. Impacts to protected species are expected to be minimal, if any, should the X-33 Program be implemented there. However, information required for a complete Section 7 consultation must await detailed design of Phase II of the program. Therefore, further analysis will be addressed in X-33 EA-II.

Over 80 sensitive plant and animal species are found or have the potential to be found on WSMR. None are known to be present at either of the specified takeoff sites. Therefore, impacts to protected species are expected to be minimal, if any, should the X-33 Program be implemented at WSMR. However, information required for a complete Section 7 consultation must await detailed design of Phase II of the program. Therefore, further analysis will be addressed in X-33 EA-II.

On the ER, more than 30 animal and more than 15 plant species are listed, proposed for listing or otherwise of special concern. Only a small number are of concern for the X-33 Program, given the proposed takeoff and processing sites (SLC-37 and KSC LC-39). Animal species include the West Indian manatee, southeastern beach mouse, Florida scrub jay, Atlantic loggerhead turtle, Atlantic green turtle, eastern indigo snake, and the gopher tortoise and gopher frog.

The West Indian manatee is listed because of the scenario of returning the X-33 spaceplane by barge from a remote landing site. The waters in which the barge must travel to reach dock—the Banana River—are home to one of the largest populations of manatees in the world, especially in the summer months. However, safeguards are in place to protect these animals. All tug captains who run these waters are required to take specific manatee awareness training sponsored by USFWS. In addition, the number of trips anticipated for this program would be relatively small. No adverse impacts to the manatee are expected.

For activities in the SLC-37 area, the southeastern beach mouse, scrub jay, gopher tortoise, and indigo snake are of concern. The launch complex, abandoned since the 1960's, is surrounded by coastal scrub habitat. In some places, the scrub has begun to reclaim some of the previously cleared areas. All five species use the areas to live and forage. The beach mouse has been trapped directly north of SLC-37. The other four could appear anywhere on-site. The procedure NASA has used in the past for projects impacting scrub habitats was to implement the KSC-wide Scrub Compensation Plan. This is an activity wherein NASA and MINWR, operated by USFWS, have set aside 120 ha (300 ac) of scrub habitat in need of rehabilitation. When projects requiring impacts to other scrub areas are implemented, NASA funds the rehabilitation actions at a rate of 0.8 ha (2 ac) of rehabilitated scrub to 0.4 ha (1 ac) of impacted scrub. The required USAF compensation at CCAS for scrub loss is a 3:1 (scrub enhancement:scrub impacted) ratio. This effort compensates not only for impacts to the Florida scrub jay, but for other listed species

utilizing this habitat as well. Therefore, prior to implementing the X-33 Program at SLC-37, NASA would perform detailed area surveys, based on the takeoff pad design, and determine the level of compensation required, if any. Results and/or compensation would be coordinated with USFWS in Jacksonville through the Section 7 process.

Loggerhead and green sea turtles nest on ER beaches. The beaches are some of the most productive nesting places in the world for these animals. Adult females come onto the beaches to lay their eggs in the spring and summer months. The hatchlings emerge 7 to 8 weeks later, dig their way to the surface, and make their way into the surf. It is at this time that they are most vulnerable, especially to predators such as birds and raccoons. However, another threat is posed to them by man. The turtles use light reflected on the water from the moon and stars to orient them to the water. Artificial lights on the dune side of the beach can confuse them and draw them away from the water. All CCAS launch complexes have produced hatchling disorientation in the past, as has interior lighting from area facilities. However, the USAF has developed a program to mark and shield nests and modify lighting on launch towers to reduce the problem. KSC LC-39 has not in the past produced a demonstrated disorientation problem. NASA, nonetheless, has also embarked on a program to survey and modify lights that might cause such a problem in the future. The problem can be mitigated (but not eliminated) by proper design, including use of low pressure sodium lamps wherever possible and shielding lights that must be a different type. A lighting management plan for the X-33 Program and consultation with USFWS would be required. Therefore, some manageable impacts to these species would be expected.

Plant species potentially impacted at SLC-37 include the beach creeper (*Ernodea littoralis*), prickly pear cactus's (*Opuntia compressa* and *Opuntia stricta*), and beach star (*Remirea maritima*). At KSC LC-39, placement of a landing pad for the vertical lander could impact any of the wetland species on the list. Details of design would allow for detailed surveys of the proposed areas. This effort will be undertaken as part of X-33 EA-II.

Information required for a complete Section 7 consultation at the ER must await detailed design of Phase II of the program, and therefore final impact determination will be addressed in EA-II. However, based on existing compensation programs, impacts are expected to be minor.

4.2.6 Cultural Resources

All three ranges have substantial numbers of cultural resources, including historic, archaeological, and Native American sites. In addition to known sites, there are also areas with a high probability of unknown cultural resource sites.

Actions necessary to implement development of any one of the X-33 takeoff sites at EAFB have potential to impact archaeological and/or historic resource values. Based on past experience, the likelihood of encountering significant resource values that cannot be avoided and/or mitigated to insignificant levels is not probable. Previous cultural resource survey work has been completed for the large majority of the area(s) potentially affected by X-33 developments and help support this conclusion. Avoidance is the preferred treatment of all archeological and historic resources. If avoidance is not possible, evaluation and mitigation measures, including worker education programs and established management practices, will be implemented where X-33 development actions may adversely impact the resources. A Cultural Resources Survey to identify, locate, and

document resources in previously unsurveyed areas may be necessary prior to project implementation. Survey results will be addressed in X-33 EA-II.

The WSSH takeoff site is not anticipated to have any impact on cultural resources since no identified cultural resource sites exist in the immediate area. There are substantial cultural resources in the WSMR LC-39 area. Mitigation may be required, primarily through locating X-33 facilities so they do not impact any of the cultural resource sites. Use of either proposed takeoff site will require a survey to identify exact locations of cultural resource sites, if any. Survey results will be addressed in X-33 EA-II.

On the ER, surveys indicate that no archeological sites are associated with either proposed takeoff site. KSC LC-39 is listed on the Register of National Historic Places due to its role in landing humans on the moon. Florida SHPO and NPS must review modifications to the complex. Cultural resource impacts on the ER will be minimal.

4.2.7 Water Resources

Impacts to water resources can be produced from several activities of the X-33 Program, such as domestic needs of employees, industrial uses of water for cleaning solutions, water deluge/sound suppression systems, and discharges to ground and surface waters.

Current water usage rates at EAFB are 16.1 mLd (4.3 mgd); at WSMR approximately 7.6 mLd (2 mgd); and at the ER 3.8 mLd (1 mgd). Since less than 100 additional workers will be employed, demand for water is expected to increase by a minimal amount in comparison to water usage in support of normal operations. Therefore, impacts are expected to be minimal .

Site preparation activities are expected to employ less than 100 people and will be of short duration, thereby minimizing impacts from this source. Operational activities are not expected to include any new or unusual processes nor to increase demand by noticeable amounts; therefore, impacts will be minimal.

The takeoff pad may or may not require water deluge. The ER is well equipped to support use of water deluge/sound suppression systems; these systems are already in place at KSC LC-39 and are currently used in launching the Space Shuttle. Use of a water deluge system may have a greater impact on EAFB and WSMR due to more limited potable water supplies. On WSMR, water may have to be trucked in to the site if potable quality water is required in the deluge system. If lower quality water is acceptable, sufficient water resources may exist on site. The impact of a water deluge system will be minor for EAFB and WSMR and minimal for the ER.

4.2.8 Geology and Soils

The only expected impacts to the geology of the three ranges result from site preparation and placement of special test equipment required at the takeoff site. There will be no geological impact due to flight operations. Required facilities are expected to include a takeoff pad and gantry structure, landing pad for the vertical lander, storage facilities for LH₂ and LOX, roadways or railways to transport the spaceplane and related equipment to the site, and all utilities. If the vertical lander is selected, a landing pad will have to be placed near the takeoff site. If a deluge

system is to be used at takeoff, it must be provided. There may also be the need for some small personnel support buildings on-site.

All four EAFB sites will require placement of takeoff structures, LOX/LH₂ storage facilities, and a landing pad. They will also require extension of utilities. The Spaceport 2000 sites will require construction of a 2.6 km (1.6 mi) road. The impact on other sites that may be considered will depend on specific locations and amount of usable infrastructure. Despite the fact that EAFB is located in a relatively aseismic area to the rest of southern California, active and potentially active faults are located close enough to generate strong ground motion. For most structures, it is expected that structural damage, even from a major earthquake, would be limited to repairable damage. Use of chemicals on-site will be minimal, and no major impacts to the surrounding soil resulting from unintended and accidental releases are expected. Comprehensive geotechnical recommendations relating to foundation design and construction are detailed in the "Geotechnical Investigation Report" prepared by Dames and Moore (1991). In addition, all structures must be constructed to specific seismic performance objectives.

Both potential takeoff sites at WSMR have minimal existing infrastructure. Both sites will require placement of takeoff structures and a landing pad. Utilities are available close to the sites, and no road construction is anticipated. The WSSH site is on a dry lakebed on gypsum soil, and the WSMR LC-39 site is a clear level site in an area of low dunes. The actual amount of required disturbance to the soil at either site should be minimal.

Facility requirements will be minimal for takeoff on the ER. Both proposed sites are existing takeoff sites. KSC LC-39 is an active launch complex with most, if not all, of the required infrastructure already in place. SLC-37 is a deactivated launch complex with road access, utilities, and some buildings already in place. Modifications would be required to the takeoff pad and gantry structure, and fuel storage facilities and a landing pad may need to be placed near the complex. Since all site preparation would be accomplished inside the confines of an existing launch complex, there would be minimal impact to the geology.

In summary, the only potential impact to site geology and soil at any of the proposed takeoff sites is due to site preparation activities. The scope of activities and size of the affected area (less than 4 ha (10 ac)) will be small. Therefore, it is expected that impact to geology and soils at any of the sites would be minimal.

4.2.9 Hazardous Materials

The primary hazardous materials associated with the X-33 Program are LH₂ and LOX used as fuel and oxidizer, respectively. The flight test program will require transportation, storage, fueling, and defueling of these materials.

There may also be other hazardous materials, such as solvents, used during assembly and processing of the spaceplane; however, quantities are expected to be small due to production of only one spaceplane and limited number of planned flights (approximately 15). Handling of hazardous materials will be done in accordance with existing federal, state, local, and range specific requirements; and storage and disposal will be accomplished utilizing existing range processes and facilities.